REMARKS

The Office Action dated March 10, 2006, has been carefully considered. Claims 28-58 are pending. New Claims 34-58 have been added to further define the protection in which Applicant is entitled. Claims 1-27 have been cancelled without prejudice or disclaimer of the subject matter contained therein. Applicant requests that the Examiner consider the above amendments and the following remarks, and pass the application to allowance.

INTERVIEW SUMMARY:

The Applicant thanks the Examiner for the courtesy of the telephonic interview on June 13, 2006.

During this interview, the claims were discussed in light of Li et al., and the difference between a visible light source and an infra-red light source. In addition, the ability of the infra-red light source having a operational wavelength of greater than 1000 nm to measure substrates having a thickness of between 1 and 1000 microns was also discussed. No agreement was reached.

RESPONSE TO OFFICE ACTION:

Rejections under 35 U.S.C. 103:

Claims 1-7, 9-12, 16-23, and 28-33 were rejected under 35 U.S.C. 103(b) as being anticipated by Li et al. (hereinafter Li), U.S. Patent No. 6,392,756.

The present invention provides an optical spectroscopic measurement system used to precisely determine the thickness of a layer of material and a method of measuring material thickness using the system. As set forth in the specification, considerable interest exists in determining the thickness of thin films used in the manufacture of micro-electronics, micro-optic, and micro-mechanical devices. Such measurement devices typically utilize visible light and are used to measure films of thickness on the order of the wavelength or less. Measurement of thicker materials such as semiconductor wafers is often done with mechanical means. Thicknesses of semiconductors which are thinner than the typical wafer thickness of 200 microns or more, however, currently are difficult to measure. Their thinness makes them too

fragile to touch mechanically. One technique utilizes single wavelength optical interference to measure a differential thickness change either from one portion of the wafer relative to the thinned part, or from a known value prior to thinning. Using this technique, optical interference occurs outside of the measured material rather than within it. Another technique measures the capacitance between electrodes above and below the wafer. One other technique, low coherence interferometry, uses an external interferometer, a polychromatic light emitting diode source and back-scattered light to measure thicknesses. This invention solves the problem of direct measurement of the thickness of such a layer, done with a non-contact, optical technique, with a high degree of accuracy by using an infrared light, which is able to partially transmit through the measured materials. See pages 3 and 4 of the Specification.

Claim 28 as amended recites a spectroscopic system for measuring thickness of a planar material using interferometry internal to the material, the system comprising: a quasi-monochromatic, tunable infra-red light source which provides wavelengths of light varied in increments of less than 0.5 nm; a photodetector that detects light reflected from or transmitted through the material; a computing device to calculate the material's transmission or reflectivity based on an interference signal from the photodetector, and wherein the material's transmission or reflectivity is used to calculate the thickness of the material based on a knowledge of a material's refractive data; and wherein the material to be measured has a thickness of 1 to 1000 microns, and the wavelength of operation of the light source is greater than 1000 nm. (Emphasis added)

Li relates to methods and apparatus for optically determining physical parameters of thin films deposited on a complex substrate, and in particular to measurements of thin films on complex substrates for obtaining physical parameters such as thickness t, refraction index n and extinction coefficient k. In Li, the method calls for providing a test beam having a wavelength range and providing a complex substrate, which has at least two layers and exhibits a non-monotonic and an appreciably variable substrate optical response over wavelength range. As set forth in Li, the "[l]ight source 56 can be a tunable laser or any other suitable light source or combination of light sources for producing a stable light wave spanning a wave-

length range delta lambda., e.g., from 190 nm to 900 nm." Col. 8, lines 43-46. Li further states that "it would be very desirable to provide a non-destructive measurement method for determining film thickness to an accuracy of 5 to 2 Angstroms or less in films whose thickness is less than 100 Angstroms or even less than 10 Angstroms." Col. 3, lines 4-8.

Li, however, does not teach or suggest a tunable infra-red light source, wherein the wavelength of operation of the light source is greater than 1000 nm. As set forth above, Li relates to a measurement device, which utilizes a light source having a wavelength of between 190 nm and 900 nm, (i.e., visible light) which is used to measure films of thickness on the order of a wavelength or less (i.e., a thin film). Accordingly, since Li does not teach or suggest the user of an Infra-red light source, wherein the wavelength of operation of the light source is greater than 1000 nm, which is used for measuring materials having a thickness of 1 to 1000 microns, Claim 28 should be allowable. Claims 29-36 (Claims 34-36 are new) are dependent from Claim 28 and should be allowable for the reasons set forth above.

Claims 13-15, and 24-27 were rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al, (U.S. Patent No. 6,392,756) and Adams (U.S. Patent No. 4,899,055), as applied to Claims 12, above, and further in view of Ruhl, Jr., et al. (U.S. Patent No. 5,357,336).

Adams relates to a method of measuring thin film thickness, especially on semiconductor substrates, in which the substrate is illuminated with ultraviolet light of a fixed wavelength corresponding to a persistent spectral line and the amount of light reflected from the substrate is detected and measured. The ultraviolet light preferably has a wavelength in the range from 240 nm to 300 nm.

Ruhl relates to optical instruments such as spectrometers and, more particularly, to a method and apparatus for calibrating such instruments

Claims 13-15, and 24-27 have been cancelled without prejudice or disclaimer of the subject matter contained therein.

New Claims 37-58:

New Claims 37 recites a spectroscopic system for measuring thickness of a planar material using interferometry internal to the material measured comprising: a quasi-monochromatic infra-red light source able to vary its wavelength in increments of less than one nanometer; a photodetector to measure the reflected or transmitted light; a computing device to calculate the material's transmission or reflectivity based on the interference signal from the detector, and wherein the material's transmission or reflectivity is used to calculate the thickness of the material based on a knowledge of a material's refractive data; and wherein the material to be measured has a thickness of 1 to 1000 microns, and the wavelength of operation of the light source is greater than 1000 nm. (Emphasis added).

Since neither Li, Adams nor Ruhl teach or suggest a spectroscopic system or method for measuring thickness of a planar material using interferometry internal to the material measured, comprising: a quasi-monochromatic infra-red light source able to vary its wavelength in increments of less than one nanometer; and wherein the material to be measured has a thickness of 1 to 1000 microns, and the wavelength of operation of the light source is greater than 1000 nm, Claim 37 should be allowable. Claims 38-48 are dependent from Claim 37 and should also be allowable for the reasons set forth above.

Claim 49 recites a method of measuring material thickness, wherein the method comprises: a method of measuring material thickness, wherein the method comprises: loading a material to be measured into a holder of a spectroscopic system, the material having a thickness of 1 to 1000 microns, wherein the system comprises: a quasi-monochromatic infra-red light source having a wavelength of operation of greater than 1000 nm, and wherein the light source is able to vary its wavelength in increments of less than one nanometer; a photodetector to measure the reflected or transmitted light; and a computing device to calculate the material's transmission or reflectivity based on the interference signal from the detector, and wherein the material's transmission or reflectivity is used to calculate the thickness of the material based on a knowledge of a material's refractive data; measuring the light reflected from or transmitted through the material at at least two different

wavelengths using the photodetector; and computing material thickness using a computing device based on data received from the detector. (Emphasis added).

Claims 50-58 contain the subject matter of cancelled Claims 18-27.

As set forth above, since neither Li, Adams nor Ruhl teach or suggest a spectroscopic method for measuring thickness of a planar material includes loading a material to be measured into a holder of a spectroscopic system, the material having a thickness of 1 to 1000 microns, wherein the system includes a quasi-monochromatic infra-red light source having a wavelength of operation of greater than 1000 nm, Claim 49 should be allowable. Claims 50-58 are dependent from Claim 49 and should also be allowable for the reasons set forth above.

Conclusion:

It is respectfully submitted that the claims are presently in condition for immediate allowance, and such action is requested. If, however, any matters remain that can be clarified by the Examiner's amendment, the Examiner is cordially invited to contact the undersigned by telephone at the number below. In the event that there are any questions concerning the amendments or the application in general, the Examiner is respectfully urged to contact the undersigned so that prosecution may be expedited.

Respectfully submitted,

BUCHANAN INGERSOLL PC

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By: _____
Kirk M. Nuzum
Registration No. 38,983

P.O. Box 1404
Alexandria, Virginia 22313-1404
(650) 622-2300